IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BOARD OF PATENT APPEALS AND INTERFERENCES

In re patent application of:
Lu, et al.

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For: PT COATING INITIATED BY INDIRECT ELECTRON BEAM FOR RESIST CONTACT HOLE

Commissioner for Patents
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APPELLANTS' APPEAL BRIEF

Sirs:

Appellants respectfully appeal the final rejection of claims 1-3, 5-10, and 12-20, in the Office Action dated February 10, 2006. A Notice of Appeal (and Pre-Appeal Brief Request for Review) was timely filed on May 10, 2006. A Notice of Panel Decision dated June 20, 2006 indicated that the claims remain rejected.

Appeal Brief

I. REAL PARTY IN INTEREST

The real party in interest is International Business Machines Corporation, Armonk, New York, assignee of 100% interest of the above-referenced patent application.

II. RELATED APPEALS AND INTERFERENCES

There are no other appeals or interferences known to Appellants, Appellants' legal representative or Assignee which would directly affect or be directly affected by or have a bearing on the Board's decision in this appeal.

III. STATUS OF CLAIMS

Claims 1-3, 5-10, and 12-20 are all the claims pending in the application and are set forth fully in the attached appendix (Section IX), are under appeal. Claims 1-20 were originally filed in the application. A non-final Office Action was issued on August 23, 2005 rejecting claims 1-20. The Appellants filed an Amendent under 37 C.F.R. §1.111 on November 22, 2005 amending claims 1, 8, and 12 and canceling claims 4 and 11. A final Office Action was issued on February 10, 2006 rejecting claims 1-3, 5-10, and 12-20. The Appellants filed a Response under 37 C.F.R. §1.116 on March 30, 2006. An Advisory Action was issued on May 2, 2006 indicating that the Response under 37 C.F.R. §1.116 filed on March 30, 2006 did not place the application in condition for allowance. The Appellants filed a Notice of Appeal, Pre-Appeal Brief Request for Review, and Attachment to Pre-Appeal Brief Request for Review timely on May 10, 2006.

Claims 1-5, 8-12, and 15-18 stand rejected under 35 U.S.C. §102(b) as being anticipated by Fujii, et al. (U.S. Patent No. 5,574,280), hereinafter referred to as Fujii. Claims 7, 14, and 20 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Fujii, in view of Berger, et al. (U.S. Publication No. 2004/0065826), hereinafter referred to as Berger. Claims 6, 13, and 19 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Fujii, in view of Christy (U.S. Patent No. 3,119,707), hereinafter

referred to as Christy. In addition, the Office Action relies on Matsui (U.S. Patent No. 6,758,900), hereinafter referred to as Matsui, and Collins (U.S. Patent No. 4,509,451), hereinafter referred to as Collins, as secondary references. Appellants respectfully traverse these rejections based on the following discussion.

IV. STATEMENT OF AMENDMENTS

A final Office Action dated February 10, 2006 stated all the pending claims 1-3, 5-10, and 12-20 were rejected. The claims shown in the appendix (Section IX) are shown in their amended form as of the November 22, 2005 response. No amendments to the claims have been made after the February 10, 2006 Final Office Action.

V. SUMMARY OF CLAIMED SUBJECT MATTER

The claimed invention provides methods of inspecting topographical features, such as vias, of the top layer of a structure. More specifically, one method begins by surrounding a partially completed integrated circuit structure with a precursor organic metal gas. Next, as defined by independent claim 1, the method directs "an angled electron beam at said structure to create secondary electron beams as said angled electron beam strikes sidewalls of said topographical features". Such features are also defined in independent claims 8 and 15, wherein the "structure" is a "partially completed integrated circuit structure", and wherein the "topographical features" are "vias". This process directs the electron beam at an angle sufficient to cause the electron beam to strike only the sidewalls of the topographical features and prevent the electron beam from reaching the bottom of the topographical features, so as to not damage the topographical features during a subsequent metal formation process. Furthermore, as defined by independent claim 1, the "secondary electron beams break down said precursor metal gas to form a metal coating on said structure" without damaging the top layer (or underlying layers). Such features are also defined in independent claims 8 and 15, wherein the "structure" is a "partially completed integrated circuit structure".

When the primary electron beam hits a surface, the emitted electrons that have an energy level less than 50 eV are called secondary electrons, and those with an energy level of 50 eV or higher are called backscattered electrons. The lower power secondary electrons are usually much more abundant relative to backscattered electrons. The same electron beam can be shared for both imaging and deposition, wherein the direct beam is used for imaging and the indirect beam is used for metal deposition. Thus, a true protection layer is formed without deforming or damaging the underlying resist feature because of the nature of the low energy of the indirect beam. The indirect electrons initiate the metal deposition (using the precursor gas). Thus, embodiments of the invention provide the indirect electron beam as an energy source to initiate metal coating with the existence of precursor gas, and also offers a coating technique to cover a wide range applications on the variety of materials, topography, shapes, etc.

After the protective metal layer is formed, the method directs an ion beam at the structure to form a groove within the top layer of the structure. Such features are defined in independent claim 1 using similar language and in independent claims 8 and 15, wherein the "structure" is a "partially completed integrated circuit structure". Following this, independent claim 1 defines that the method inspects the "topographical features exposed by said groove in said top layer of said structure". As further defined by independent claims 8 and 15, the "topographical features" are "cross sections of said vias" and the "structure" is a "partially completed integrated circuit structure".

VI. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

The issues presented for review by the Board of Patents Appeals and Interferences are whether claims 1-3, 5, 8-10, 12 and 15-18 are unpatentable under 35 U.S.C. §102(b) as being anticipated by Fujii, whether claims 7, 14, and 20 are unpatentable under 35 U.S.C. §103(a) as being unpatentable over Fujii in view of Berger, and whether claims 6, 13, and 19 are unpatentable under 35 U.S.C. §103(a) as being unpatentable over Fujii in view of Christy.

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VII. ARGUMENT

A. The Prior Art Rejections of Claims 1-3, 5, 8-10, 12, and 15-18

1. The Position in the Office Action

The Office Action states:

Fujii discloses (a) Use of electron beam irradiation unit 17 to irradiate hexacarbonyl tungsten gas (organic metal gas) blown by the organic gas source 14 onto the surface of semiconductor device 5, and while irradiated with the energy beam source 17 a tungsten film is formed on the surface. A portion of the sample 5 at the predetermined area is removed (forms a groove) by ion beam sputtering, exposing the cross-section (e.g. wiring at the boundary) of the semiconductor. Subsequent irradiation at the section with the focused ion beam generates secondary particles, which are detected by a detector 6, and then the image of the section is displayed on the display 7 (inspecting the exposed area), as recited in claims 1, 8, and 15. See Column 2, line 40-49; Column 4, line 34-45; Column 5, line 47-57; and Figure 4 below; (b) The use of a tilted stage shown in Figures 6A-6C; as recited in claims 2, 3, and 10. It is implied herein that, secondary electrons are generated when electron beam source 17 irradiates semiconductor sample 5, and these generated secondary electrons, along with the primary beam electrons, contributed to the dissociation (breakdown) of the organic gas, which results in deposition of the metal coating onto the semiconductor surface, as recited in claims 4, 12, and 15. It is also implied herein that, secondary electrons always have less energy than the primary electrons that generate them, as recited in claims 5 and 12.

2. Appellants' Position

a. Independent Claim 1

Appellants traverse this rejection because Fujii teaches detecting and imaging a sample using secondary *particles* formed by an *ion* beam, whereas the claimed

methodology defined by independent claim 1 forms a metal coating using secondary *electron beams*, which are created when angled electron beams strike topographical features of a structure (claim 1 recites "directing an angled electron beam at said structure to create secondary electron beams as said angled electron beam strikes sidewalls of said topographical features, wherein said secondary electron beams break down said precursor metal gas to form a metal coating on said structure"). Nothing within Fujii discloses secondary electron beams that are used to form a metal coating.

Appellants respectfully submit that the rejection is incorrectly based on the premise that Fujii discloses "use of an electron beam irradiation unit 17 to irradiate hexacarbonyl tungsten gas (organic metal gas) blown by the organic gas source 14 onto the surface of semiconductor device 5, and while irradiated with the energy beam source 17 a tungsten film is formed on the surface" (February 10, 2006 Office Action, p. 2, item 3(a)). The Office Action also asserts that subsequent irradiation at the section with the focused ion beam generates secondary particles, which are detected by a detector (February 10, 2006 Office Action, p. 2, item 3(a)).

More specifically, as provided in column 1, lines 7 – 12 of Fujii, "[t]he apparatus and method are used for processing a predetermined area on a sample by irradiation with the focused ion beam and by *scanning, and/or observing the sample surface* by detecting *secondary particles generated by the irradiation with the focused ion beams*".(emphasis added). Moreover, as provided in column 1, lines 28 – 32 of Fujii, "the secondary particles generated by the irradiation at the section with the focused ion beam are detected by a detector 6, and then the image of the section is displayed on the display 7."

Thus, Fujii discloses, *imaging* a sample surface using secondary *particles* generated by an *ion* beam. However, nothing in Fujii mentions forming a metal coating using secondary *electron beams*, which are created from angled electron beams.

In other words, the secondary *particles* disclosed in Fujii are not analogous to the secondary *electron beams* of the claimed invention. Unlike the claimed invention, the secondary particles of Fujii are not created by an *electron* beam; rather, they are created by an *ion* beam (column 1, lines 7-12, 28-32). Further unlike the claimed invention, the

secondary particles of Fujii are not used to form a metal coating; rather, they are utilized to form an image of the sample, i.e., they are detected by a detector to form an image of a section of the sample (column 1, lines 28-32, and column 4, lines 4-8). Instead, the metal coating in Fujii is formed with a *direct* electron beam (which does not create secondary electron beams) and the inorganic metal gas (column 2, lines 40-49), wherein the method of Fujii is not concerned about damaging delicate components underlying the sample surface.

Conversely, as described in paragraph 39 of Appellants' disclosure, when the primary electron beam hits a surface, the emitted electrons that have an energy level less than 50 eV are called secondary electrons, and those with an energy level of 50 eV or higher are called backscattered electrons. The lower power secondary electrons are usually much more abundant relative to backscattered electrons. The same electron beam can be shared for both imaging and deposition, where the direct beam is used for imaging, and the *indirect beam* is used for metal deposition to form a true protection layer *without deforming or damaging the underlying resist feature because of the nature of the low energy of the indirect beam.* The indirect electrons initiate the metal deposition (using the precursor gas). Thus, the claimed invention provides the indirect electron beam as an energy source to initiate metal coating with the existence of precursor gas, and also offers a coating technique to cover a wide range applications on the variety of materials, topography, shapes, etc.

Therefore, contrary to the position taken in the Office Action, Appellants submit that Fujii does not disclose using indirect beams (i.e., secondary electron beams) formed from an angled electron beam to form a metal coating. Rather, Fujii discloses imaging a sample surface using secondary particles generated by an ion beam. Moreover, the metal coating is formed in Fujii with a direct electron beam (which does not create secondary electron beams) and an inorganic metal gas, wherein the method of Fujii is not concerned about damaging delicate components underlying the sample surface. Further, as more fully described in below in section A.2.d, the ion beams of Fujii are not directed towards the sample at an angle (See Fujii, FIGS. 6A – 6B). Thus, it is Appellants' position that

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Fujii does not teach the claimed feature of "directing an angled electron beam at said structure to create secondary electron beams as said angled electron beam strikes sidewalls of said topographical features, wherein said secondary electron beams break down said precursor metal gas to form a metal coating on said structure" as defined by independent claim 1.

In response to Appellants' arguments, the Office Action further references Matsui and Collins (February 10, 2006 Office Action, p. 8, para. 2-4). Specifically, citing column 1, lines 25-28 of Matsui, the Office Action asserts that CVD based methods of producing a micro three-dimensional structure are classified into three which use light (laser), a focused electron beam, and a focused ion beam, respectively (February 10, 2006 Office Action, p. 8, para. 2).

More specifically, Matsui discloses CVD deposition using a focused *ion beam* 4, which as the Office Action acknowledges, is different from a focused *electron beam* (February 10, 2006 Office Action, p. 8, para. 2), wherein the ion beam 4 and a material gas 3 form a first-layer deposit 5 (Matsui, col. 3, lines 33-36, FIG. 1(a)). However, Matsui does not teach using an angled *electron* beam to create secondary electron beams as the angled electron beam strikes topographical features, wherein the secondary electron beams break down precursor metal gas to form a metal coating. As noted above, the first-layer deposit 5 in Matsui is formed via the ion beam 4 and the material gas 3, not via secondary electron beams created from an electron beam.

Furthermore, the first-layer deposit 5 is formed *before* the secondary electrons 6 of Matsui. More specifically, it is only after the first-layer deposit 5 is formed that ions can impinge on the first-layer deposit 5 to release secondary electrons 6 (Matsui, col. 3, lines 37-39, FIG. 1(b)). Therefore, because the first-layer deposit 5 is formed prior to the creation of the secondary electrons 6, the secondary electrons 6 clearly cannot be used to form the first-layer deposit 5.

In fact, the secondary electrons 6 are used to form a terrace 7, not a metal coating (Matsui, col. 3, lines 37-39, FIG. 1(b)). Moreover, the terrace is formed over the first-

layer deposit 5 (Matsui, FIG. 1(b)), which, as described above, is formed by the ion beam 4 and the material gas 3, not by the secondary electrons 6.

After the secondary electrons 6 form the terrace 7 over the first-layer deposit 5, the ion beam 4 is once more used to form a second layer deposit 8 over the terrace 7. Again, the secondary electrons 6 are not used to form the second layer deposit 8.

Therefore, Appellants respectfully submit that Matsui does not teach or suggest forming a metal coating using secondary electrons formed from an electron beam; rather, the first-layer deposit 5 in Matsui is formed via the ion beam 4, wherein the first-layer deposit 5 is formed prior to the formation of the secondary electrons 6. Thus, it is Appellants' position that Matsui fails to teach or suggest the claimed feature of "directing an angled electron beam at said structure to create secondary electron beams as said angled electron beam strikes sidewalls of said topographical features, wherein said secondary electron beams break down said precursor metal gas to form a metal coating on said structure" as defined by independent claim 1.

Furthermore, the Office Action argues that Collins discloses using electron beams in assisted CVD deposition (February 10, 2006 Office Action, p. 8, para. 3-4). In support for this contention, the Office Action cites column 2, lines 13-28 of Collins, which provides for the deposition and growth of microelectronic thin films (February 10, 2006 Office Action, p. 8, para. 3). The Office Action asserts that the method uses d.c. electron beams to dissociate gas molecules into constituent atoms either directly by electron impact or indirectly by vacuum ultraviolet photons or finally via subsequent rare gas sensitized (February 10, 2006 Office Action, p. 8, para. 3). Additionally, the Office Action argues that the film donor atoms so formed diffuse to a substrate surface and react to form a solid thin film; alternatively, or in tandem, dissociation of donor molecules on the substrate surface can occur again either via electron impact or photoabsorption and film growth occurs (February 10, 2006 Office Action, p. 8, para. 4).

However, the electrons in Collins collide with the reactant gas molecules directly; they do not come into direct contact with the substrate, i.e., the structure having the film formed thereon. As noted in Collins, column 2, lines 60-68 – column 3, line 1, "[h]igh

energy electrons emitted from the glow discharge electron gun collide *directly with the reactant gas molecules* thereby dissociating these reactant species and creating free radicals including excited atoms and positive and negative ions. Alternatively the vacuum ultraviolet rare gas photons and rare gas sensitized reactions can cause reactant dissociation via photo-absorption and sensitized gas collisions respectively. Secondary electrons are emitted in the ionizing collisions of beam electrons *with atoms and molecules.*" (Emphasis added). Moreover, as provided in the abstract of Collins, "[t]he electron beams are spatially confined and excite only a localized region above the substrate so that direct plasma bombardment of the substrate is avoided."

Therefore, Appellants respectfully submit that Collins does not teach or suggest directing an electron beam *at a structure* to create secondary electron beams *as the electron beam strikes topographical features of the structure.* Rather, the electron beams in Collins collide with the *reactant gas molecules* directly, not the substrate/structure. Moreover, the electron beams are spatially confined and excite only a localized region above the substrate so that direct plasma bombardment of the substrate is avoided. Thus, it is Appellants' position that Collins fails to teach or suggest the claimed feature of "directing an angled electron beam at said structure to create secondary electron beams as said angled electron beam strikes sidewalls of said topographical features", as defined by independent claim 1.

Further in response to Appellants' arguments, the Office Action asserts that Christy discloses that all metals and some insulators will emit secondary electrons when bombarded by electrons (February 10, 2006 Office Action, p. 8, para. 5 – p. 9, para. 1-2). However, nothing within Christy mentions using such secondary electrons to break down precursor metal gas to form a metal coating.

More specifically, the secondary electrons of Christy are not used to break down metal gas to form a coating; rather, the secondary electrons are removed from the target substrate for the purpose of attracting other electrons to the target surface to produce a thin film. As provided in column 5, lines 33-39 of Christy, the arrival of an impinging electron will cause more than one electron (i.e., the secondary electrons) to be removed

from the target substrate thereby leaving the substrate with an effective positive charge with respect to its original condition. The effect is therefore to attract electrons to the target substrate surface thereby properly producing a thin film by the polymerizing process.

In addition, Appellants submit that the electrons disclosed in Christy are not used to form a *metal* coating – the electrons are used to form an *insulative* film. Specifically, as discussed in column 3, lines 31-33 of Christy, an electron gun 16 is directed at a metal film 15 that is to be covered with the insulative film. Further, as noted in column 4, lines 3-6 of Christy, the electron beam has the effect of cross-linking the vapor molecules of the polymerizable material used and thereby produces a thin insulative film. As such, the creation of an insulative film teaches away from the metal coating formed in the claimed invention.

Accordingly, it is Appellants' position that Christy does not teach the use of secondary electrons to break down metal gas to form a metal coating. Rather, Christy discloses removing secondary electrons from the target substrate for the purpose of attracting other electrons. Moreover, the creation of an insulative film in Christy teaches away from the metal coating formed in the claimed invention. Therefore, Appellants submit that Christy fails to teach or suggest the claimed feature wherein "said secondary electron beams break down said precursor metal gas to form a metal coating on said structure" as defined by independent claim 1.

Therefore, Appellants respectfully submit that neither Fujii, Matsui, Collins, nor Christy either individually or in combination, teach or suggest "directing an angled electron beam at said structure to create secondary electron beams as said angled electron beam strikes sidewalls of said topographical features, wherein said secondary electron beams break down said precursor metal gas to form a metal coating on said structure" as defined by independent claim 1. Therefore, independent claim 1 is patentable over Fujii, Matsui, Collins, and Christy. In view of the foregoing, the Board is respectfully requested to reconsider and withdraw this rejection.

b. Independent Claim 8

Independent claim 8 discloses all of the limitations of claim 1, wherein the "structure" in claim 1 is a "partially completed integrated circuit structure", and wherein the "metal gas" in claim 1 is an "organic metal gas". Furthermore, claim 8 has the additional limitation wherein "cross sections" of the topographical features are inspected. Therefore, claim 8, having the three additional claim limitations described above, is narrower in scope than claim 1. Accordingly, because claim 1 is patentable over the prior art of record (as more fully described above in Section A.2.a), and because claim 1 is broader in scope than claim 8, claim 8 is therefore also patentable over the prior art. In addition, it is noted that neither Fujii, Matsui, Collins, nor Christy mention partially completed integrated circuit structures.

Therefore, in view of the foregoing, Appellants respectfully submit that neither Fujii, Matsui, Collins, nor Christy teach or suggest the claimed feature of "directing an angled electron beam at said partially completed integrated circuit structure to create secondary electron beams as said angled electron beam strikes sidewalls of said topographical features, wherein said secondary electron beams break down said precursor metal gas to form a metal coating on said partially completed integrated circuit structure" as defined by independent claim 8. Furthermore, Fujii, Matsui, Collins, and Christy fail to teach or suggest the claimed feature of "surrounding said partially completed integrated circuit structure with a precursor organic metal gas; ... directing an ion beam at said partially completed integrated circuit structure to form a groove within said top layer of said partially completed integrated circuit structure; and inspecting cross sections of said topographical features exposed by said groove in said top layer of said partially completed integrated circuit structure" as defined by independent claim 8. Therefore, independent claim 8 is patentable over Fujii, Matsui, Collins, and Christy. In view of the foregoing, the Board is respectfully requested to reconsider and withdraw this rejection.

c. Independent Claim 15

Independent claim 15 discloses all of the limitations of claim 1, wherein the "structure" in claim 1 is a "partially completed integrated circuit structure", wherein the "metal gas" in claim 1 is an "organic metal gas", and wherein the "topographical features" in claim 1 are "vias". Furthermore, claim 15 has the additional limitation wherein "cross sections" of the vias are inspected. Therefore, claim 15, having the four additional claim limitations described above, is narrower in scope than claim 1. Accordingly, because claim 1 is patentable over the prior art of record (as more fully described above in Section A.2.a), and because claim 1 is broader in scope than claim 15, claim 15 is therefore also patentable over the prior art. In addition, it is noted that neither Fujii, Matsui, Collins, nor Christy mention a partially completed integrated circuit structure or vias.

Therefore, in view of the foregoing, Appellants respectfully submit that neither Fujii, Matsui, Collins, nor Christy teach or suggest the claimed feature of "directing an angled electron beam at said partially completed integrated circuit structure to create secondary electron beams as said angled electron beam strikes the sidewalls of said vias, wherein said secondary electron beams break down said precursor metal gas to form a metal coating on said partially completed integrated circuit structure" as defined by independent claim 15. Furthermore, Fujii, Matsui, Collins, and Christy fail to teach or suggest the claimed feature of "surrounding said partially completed integrated circuit structure with a precursor organic metal gas; ... directing an ion beam at said partially completed integrated circuit structure to form a groove within said top layer of said partially completed integrated circuit structure; and inspecting cross sections of said vias exposed by said groove in said top layer of said partially completed integrated circuit structure" as defined by independent claim 15. Therefore, independent claim 15 is patentable over Fujii, Matsui, Collins, and Christy. In view of the foregoing, the Board is respectfully requested to reconsider and withdraw this rejection.

d. Dependent Claims 2, 9, and 16

It is Appellants' position that dependent claims 2, 9, and 16 are similarly patentable, not only because of their dependency from patentable independent claims (as more fully described above in sections A.2.a – A.2.c), but also because of the additional features of the invention they define. More specifically, Appellants traverse this rejection because Fujii discloses positioning an ion beam irradiation unit directly above a sample to be imaged, which therefore produces an ion beam that is perpendicular to the sample. As such, the ion beam strikes the top surface of the sample. Conversely, the claimed invention defined by dependent claims 2, 9, and 16 directs an electron beam at an angle sufficient to cause the electron beam to strike sidewalls of topographical features of the structure (dependent claims 2 and 9 each recite "said process of directing said angled electron beam directs said electron beam at an angle sufficient to cause said electron beam to strike the sidewalls of said topographical features"; and, dependent claim 16 provides the same wherein the "topographical features" are "vias").

The Office Action references FIGS. 6A – 6C of Fujii to assert that Fujii discloses an angled electron beam that strikes sidewalls of the sample. First of all, as discussed above in section A.2.a, Fujii directs an *ion* beam at the sample, not an *electron* beam. As illustrated in FIGS. 6A – 6B of Fujii, ion beam irradiation units 2 and 3 produce ion beams 11 and 12, respectively.

As further illustrated in FIGS. 6A – 6B, the ion beams 11 and 12 are not directed at angle towards the sample 36. Specifically, because the sample 36 is repositioned to be directed towards the ion irradiation unit 3 (FIG. 6B), the resulting ion beam 12 is not directed at an angle towards the sample 36. Rather, because the sample 36 is directed towards the ion irradiation unit 3, the ion irradiation unit 3 produces an ion beam 12 that is perpendicular to the sample 36. Therefore, Appellants submit that Fujii fails to teach directing an angled electron beam at a structure, as defined by dependent claims 2, 9, and 16.

In addition, because the ion beams 11 and 12 of Fujii are not directed towards the sample 36 at an angle, the ion beams 11 and 12 do not strike sidewalls of the sample 36.

Instead, the ion beams 11 and 12, which are perpendicular to the sample 36, strike the *top surface* of the sample 36 (See Fujii, FIGS. 6A – 6B). Accordingly, it is Appellants' position that Fujii fails to teach the claimed features wherein "said process of directing said angled electron beam directs said electron beam at an angle sufficient to cause said electron beam to strike the sidewalls of said topographical features" as defined by dependent claims 2 and 9, and wherein the "topographical features" are "vias" as defined by dependent claim 16.

e. Dependent Claims 3, 10, and 17

It is Appellants' position that dependent claims 3, 10, and 17 are similarly patentable, not only because of their dependency from patentable independent claims (as more fully described above in sections A.2.a – A.2.c), but also because of the additional features of the invention they defined.

f. Dependent Claims 5, 12, and 18

It is Appellants' position that dependent claims 5, 12, and 18 are similarly patentable, not only because of their dependency from patentable independent claims (as more fully described above in sections A.2.a – A.2.c), but also because of the additional features of the invention they defined. More specifically, the Office Action asserts that it is implied that secondary electrons always have less energy than the primary electrons that generate them (February 10, 2006 Office Action, p. 4, para. 2). However, the Office Action does not provide any support for this implied assertion.

None of the references used to reject independent claims 1, 8, or 15, from which claims 5, 12, and 15 depend upon, respectively, teach that secondary electrons have less energy than primary electrons that generate them. Thus, given the teachings of the cited prior art references, it is not inherent that the secondary electrons of the claimed invention have less energy than the angled electron beam. Accordingly, Appellants respectfully submit, that contrary to the position taken in the Office Action, it cannot be

implied that "said secondary beams have less energy than said angled electron beam" as defined by claims 5, 12, and 15.

B. The Prior Art Rejections of Claims 7, 14, and 20

1. The Position in the Office Action

The Office Action states:

Fujii discloses nearly all the limitations of claims 7, 14, and 20 but fails to teach the use of an incident electron beam angle between 20 and 70 degrees relative to the sample surface. However Berger discloses a particle-beam system 10 for obtaining an image of a cross-section of a workpiece 11, as shown in FIG. 1, includes a shaped-beam ion-projection column 12 configured to project an image of an aperture onto the front surface 14 of the workpiece 11, and further includes a focused-particle-beam imaging column 20, which is an electron beam provided by a scanning electron microscope. The column 20 is oriented along a second axis 22 that is canted relative to the first axis 18 so that it intersects the first axis 18 at a selected angle. The selected angle is preferably between thirty and sixty degrees, as recited in claims 7, 14, and 20. See Paragraph's [0024], [0055], [0039], and Figure 1.

Therefore it would have been obvious to one of ordinary skill in the art that the ion beam apparatus and method of Fujii can be modified to use the incident electron beam angles specified in the apparatus and method of Berger, to provide a method and system for imaging a cross-section of a substrate that is capable of switching from a cutting mode to an imaging mode in order to view the vertical wall of the excavated cross-section.

2. The Appellants' Position (Claims 7, 14, and 20)

Appellants' submit that Berger is introduced by the Office Action for the limited purpose of illustrating a method of orienting an electron beam at angle between thirty and sixty degrees (February 10, 2006 Office Action, pp. 4-5, item 5). Claims 7, 14, and 20 of

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Appellants' invention recites "directing said electron beam at an angle between approximately 20 and 70 degrees with respect to the surface of the top layer of said [partially completed integrated circuit] structure". As provided in the abstract of Berger, a system is provided for obtaining an image of a cross-sectional surface of a workpiece, including a shaped beam ion projection column oriented along a first axis. The ion projection column projects an image of an aperture on the workpiece surface, thereby excavating a portion of the surface and exposing a cross-sectional surface. A focused particle beam column, typically a scanning electron microscope, is oriented along a second axis that intersects the first axis at a selected angle. This focused particle beam column generates a particle beam that is used to image the cross-sectional surface exposed by the ion projection column.

However, nothing within Berger mentions the creation or use of secondary electron beams. Moreover, nothing within Berger mentions forming a metal coating using precursor metal gas. Rather, Berger is introduced by the Office Action for the limited purpose of illustrating a method of orienting an electron beam at angle between thirty and sixty degrees.

Thus, it is Appellants' position that Berger fails to teach or suggest the claimed feature of "directing an angled electron beam at said structure to create secondary electron beams as said angled electron beam strikes sidewalls of said topographical features, wherein said secondary electron beams break down said precursor metal gas to form a metal coating on said structure" as defined by independent claim 1, from which claim 7 depends upon. Moreover, Berger fails to teach or suggest the claimed feature wherein the "structure" is a "partially completed integrated circuit structure", wherein the "metal gas" is an "organic metal gas", and wherein "cross sections" of the topographical features are inspected as defined by independent claims 8 and 15, from which claims 14 and 20, respectively, depend upon. Additionally, Berger fails to teach or suggest the claimed feature wherein the "topographical features" are "vias" as defined by independent claim 15, from which claim 20 depends upon. Accordingly, Appellants

submit that the Office Action's assertion that Berger discloses orienting an electron beam at angle between thirty and sixty degrees is moot.

It is Appellants' position that because independent claims 1, 8, and 15 are patentable over Berger, as illustrated herein, the dependent claims that Berger is presented to reject, i.e., dependent claims 7, 14, and 20, are patentable because of their dependency from patentable independent claims. In view of the foregoing, the Board is respectfully requested to reconsider and withdraw this rejection.

C. The Prior Art Rejections of Claims 6, 13, and 19

1. The Position in the Office Action

The Office Action states:

Fujii discloses nearly all the limitations of claims 6, 13, and 19, but fails to teach the use of electron beams having energy levels between 100 and 10,000 electron volts to form a metal film. However, Christy discloses a method for deposition of thin films that includes the use of a substrate located within an evacuated chamber, that is enveloped with the vapor molecules of a metal-organic compound, which is irradiated with a beam of electrons accelerated at 225 volts, whereby a metal film is formed as the vapor molecules adsorbed on the substrate are decomposed by the electron beam, as recited in claims 6, 13, and 19. See Column 2, line 24-32; and Column 4, line 27-40.

Therefore it would have been obvious to one of ordinary skill in the art that the ion beams apparatus and method of Fujii can be modified with the accelerating potentials in the apparatus and method of Christy, to provide a beam of electrons directed against a vapor of metal organic molecules to form a metal film on a substrate.

2. The Appellants' Position

Appellants' submit that Christy is introduced by the Office Action for the purpose of illustrating an electron beam accelerated at 225 volts (February 10, 2006 Office Action, p. 6, item 6). Claims 6, 13, and 19 of Appellants' invention recites "using an

electron beam having an energy level of approximately between 100 and 10,000 electron volts". However, as more fully discussed above in section A.2.a, Christy fails to teach or suggest using secondary electrons to break down metal gas to form a coating; rather, the secondary electrons in Christy are removed from the target substrate for the purpose of attracting other electrons to the target surface. Further, as also discussed above in section A.2.a, the electrons disclosed in Christy are not used to form a *metal* coating – the electrons are used to form an *insulative* film. As such, the creation of an insulative film teaches away from the metal coating formed in the claimed invention.

Thus, it is Appellants' position that Christy fails to teach or suggest the claimed feature "wherein said secondary electron beams break down said precursor metal gas to form a metal coating on said structure" as defined by independent claim 1, from which claim 6 depends upon. Moreover, Christy fails to teach or suggest the claimed feature wherein the "structure" is a "partially completed integrated circuit structure", wherein the "metal gas" is an "organic metal gas", and wherein "cross sections" of the topographical features are inspected as defined by independent claims 8 and 15, from which claims 13 and 19, respectively, depend upon. Accordingly, Appellants submit that the Office Action's assertion that Christy discloses an electron beam accelerated at 225 volts is moot.

It is Appellants' position that because independent claims 1, 8, and 15 are patentable over Christy, as illustrated herein, the dependent claims that Christy is presented to reject, i.e., dependent claims 6, 13, and 19, are patentable because of their dependency from patentable independent claims. In view of the foregoing, the Board is respectfully requested to reconsider and withdraw this rejection.

VIII. CONCLUSION

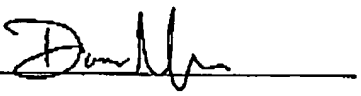
In view of the foregoing, the Appellants respectfully submit that the collective cited prior art do not teach or suggest the features defined by independent claims 1, 8, and 15, and as such, claims 1-3, 5, 8-10, 12, and 15-18 are patentable over Fujii alone or in

combination with one another. Further, dependent claims 2-3, 5-7, 9-10, 12-14, and 16-20 are similarly patentable over Fujii alone or in combination with one another, not only by virtue of their dependency from patentable independent claims, respectively, but also by virtue of the additional features of the Appellants' claimed invention they define. Thus, the Appellants respectfully request that the Board reconsider and withdraw the rejections of claims 1-3, 5-10, and 12-20 and pass these claims to issue.

Please charge any deficiencies and credit any overpayments to Attorney's Deposit Account Number 09-0458.

Respectfully submitted,

Date: 7/7/06



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Appeal Brief

IX. CLAIMS APPENDIX

1. A method of inspecting topographical features of the top layer of a structure, said method comprising:

surrounding said structure with a precursor metal gas;

directing an angled electron beam at said structure to create secondary electron beams as said angled electron beam strikes sidewalls of said topographical features, wherein said secondary electron beams break down said precursor metal gas to form a metal coating on said structure;

directing an ion beam at said structure to form a groove within said top layer of said structure; and

inspecting said topographical features exposed by said groove in said top layer of said structure.

2. The method in claim 1, wherein said process of directing said angled electron beam directs said electron beam at an angle sufficient to cause said electron beam to strike the sidewalls of said topographical features.

3. The method in claim 1, wherein said process of directing said angled electron beam comprises tilting a stage that supports said structure.

4. (Canceled).

5. The method in claim 1, wherein said secondary beams have less energy than said angled electron beam.

6. The method in claim 1, wherein said process of directing said angled electron beam comprises using an electron beam having an energy level of approximately between 100 and 10,000 electron volts.

7. The method in claim 1, wherein said process of directing said angled electron beam comprises directing said electron beam at an angle between approximately 20 and 70 degrees with respect to the surface of the top layer of said structure.

8. A method of inspecting topographical features of the top layer of a partially completed integrated circuit structure, said method comprising:

surrounding said partially completed integrated circuit structure with a precursor organic metal gas;

directing an angled electron beam at said partially completed integrated circuit structure to create secondary electron beams as said angled electron beam strikes sidewalls of said topographical features, wherein said secondary electron beams break down said precursor metal gas to form a metal coating on said partially completed integrated circuit structure;

directing an ion beam at said partially completed integrated circuit structure to form a groove within said top layer of said partially completed integrated circuit structure; and

inspecting cross sections of said topographical features exposed by said groove in said top layer of said partially completed integrated circuit structure.

9. The method in claim 8, wherein said process of directing said angled electron beam directs said electron beam at an angle sufficient to cause said electron beam to strike the sidewalls of said topographical features and prevent said electron beam from reaching the bottom of said topographical features.

10. The method in claim 8, wherein said process of directing said angled electron beam comprises tilting a stage that supports said partially completed integrated circuit structure.

11. (Canceled).

12. The method in claim 8, wherein said secondary beams have less energy than said angled electron beam.

13. The method in claim 8, wherein said process of directing said angled electron beam comprises using an electron beam having an energy level of approximately between 100 and 10,000 electron volts.

14. The method in claim 8, wherein said process of directing said angled electron beam comprises directing said electron beam at an angle between approximately 20 and 70 degrees with respect to the surface of the top layer of said partially completed integrated circuit structure.

15. A method of inspecting vias of the top layer of a partially completed integrated circuit structure, said method comprising:

surrounding said partially completed integrated circuit structure with a precursor organic metal gas;

directing an angled electron beam at said partially completed integrated circuit structure to create secondary electron beams as said angled electron beam strikes the sidewalls of said vias, wherein said secondary electron beams break down said precursor metal gas to form a metal coating on said partially completed integrated circuit structure;

directing an ion beam at said partially completed integrated circuit structure to form a groove within said top layer of said partially completed integrated circuit structure; and

inspecting cross sections of said vias exposed by said groove in said top layer of said partially completed integrated circuit structure.

16. The method in claim 15, wherein said process of directing said angled electron beam directs said electron beam at an angle sufficient to cause said electron beam to strike the sidewalls of said vias and prevent said electron beam from reaching the bottom of said vias.

17. The method in claim 15, wherein said process of directing said angled electron beam comprises tilting a stage that supports said partially integrated circuit structure.

18. The method in claim 17, wherein said secondary beams have less energy than said angled electron beam.

19. The method in claim 15, wherein said process of directing said angled electron beam comprises using an electron beam having an energy level of approximately between 100 and 10,000 electron volts.

20. The method in claim 15, wherein said process of directing said angled electron beam comprises directing said electron beam at an angle between approximately 20 and 70 degrees with respect to the surface of the top layer of said partially completed integrated circuit structure.

X. EVIDENCE APPENDIX

There is no other evidence known to Appellants, Appellants' legal representative or Assignee which would directly affect or be directly affected by or have a bearing on the Board's decision in this appeal.

XI. RELATED PROCEEDINGS APPENDIX

There is no other related proceedings known to Appellants, Appellants' legal representative or Assignee which would directly affect or be directly affected by or have a bearing on the Board's decision in this appeal.